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SPECIAL ISSUE ON Innovations in Future IoT Communications

Guest Editors: 1Ramasamy V, 2Bibudhendu Pati, 3Abhishek Majumder and 4Sheng-Lung Peng

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This special issue of Frontiers focuses on the Innovations in Future IoT Communications. The research topics of the papers in this special issue include Industrial Internet of Things (IIoT) for global manufacturing industries, AI and IoT application for the people, organizations, and government offices, IoT based architecture for real-time monitoring of flood propagation and evacuation routing in a GIS environment, and a system that helps a blind people to move from point A toward B without the need of other's help.

The first paper has been at the forefront of focus areas across the global manufacturing industries using the Industrial Internet of Things (IoT). The authors modeled the predictive maintenance tool for condition-based monitoring often used for identifying asset risks in rotating equipment (i.e., Fans, Pumps, etc.). The physical assets, if neglected tend to be unsafe and fail to deliver their intended performance or purpose in a manufacturing concern. The authors attempted to showcase the application of IIoT for Rotating Equipment in an Integrated Steel Plant.

The second paper has been developed with the principal objective of increasing business standards and the exploration of better approaches for serving clients while keeping up with the minimal expense and various techniques of AI and IoT. The authors designed the paper for the people, organizations, and government offices to use these models to extract knowledge from hidden information and presented a systematic summary about the refinement in business and industry in terms of AI and IoT application.

The third paper aimed to develop IoT based architecture for real-time monitoring of flood propagation and evacuation routing in a GIS environment. The authors prepared a flood zonation map with their study area as Kaziranga national park, a UNESCO world heritage site, based on the past satellite image, DEM, topographical sheets, hydrological, and climatological data. The authors have been used satellite images for Spatio-temporal analysis of land use/land cover of the study area. Also, the authors have been developed an architecture to apply IoT sensors on controlling parameters of flood occurrence based on flood zonation analysis. This will help to determine the characteristics of flood propagation and find out an immediate rescue route from that area depending upon the stages of flood propagation.

The fourth paper considers blind people with their many challenges of day-to-day life due to the lack of vision. The authors have been developed a system that helps blind people to move from point A toward B without the need for others' help by considering their lack of vision. The developed system uses ultrasonic sensors that detect objects at a certain distance so that blind can get notified about the obstacles in front of them.

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ABSTRACT

Industrial Internet of Things (IIoT) has been in the forefront of focus areas across the global manufacturing industries. A manufacturing concern delivers its value to its customer through products made using assets that include financial, physical and human resources. Of these, the physical assets, if neglected tend to be unsafe and fail to deliver its intended performance or purpose. Condition based monitoring is a predictive maintenance tool often used for identifying asset risks in rotating equipment (i.e., Fans, Pumps, etc.).

This paper attempts to showcase the application of IIoT for Rotating Equipment in an Integrated Steel Plant.

1. INTRODUCTION

Asset Integrity is defined as the ability of an asset to perform its required function effectively and efficiently whilst protecting health, safety and environment. Asset Integrity Management (AIM) is the means of ensuring that the people, systems, processes and resources that deliver integrity are in place, in use and will perform when required over the whole lifecycle of the asset. Asset Management translates the organization’s objectives into asset-related decisions, plans and activities, using a risk-based approach. The objective of AIM is to enhance the life of the asset, improve availability and performance by adopting new generation technology while ensuring assets are safe and comply to the regulatory standards. TCE is supporting one of its valued customers in deploying Asset Integrity Management through onsite-offshore model.

Rotating Equipment constitute a major asset group in an integrated steel plant that support in ensuring the process of steel making and its allied activities. Condition monitoring for the equipment allows planned maintenance. This helps prevent asset failures, reduce unplanned downtime and thereby production losses.

The Industrial Internet of Things (IIoT) connects the world of industrial things like sensors, actuators, controllers, robots, etc to computational capabilities residing in internet-based storage and analytics. IIoT and Industry 4.0 have already shown enormous potential in numerous applications in manufacturing plants globally. IIoT for asset monitoring is expected to produce an economic value of approx. 200-500 billion USD by 2025 [1]. Condition-based maintenance (CBM), involving real-time sensing and predictive maintenance, is viewed as the “easy win” among IIoT applications [2-5] with many new online sensors being introduced annually.
2. ASSET INTEGRITY MANAGEMENT

By definition, an Asset is anything that has a value, or a potential value to an organization. Assets of an organization can be, its cash capital, human resources, and various physical assets like plant & equipment, and their support structures, which it uses to transform the feed material into products for its customer. Managing aging physical assets, is voted as the second biggest concern in a manufacturing organisation across the globe.

When an asset operates, its performance deteriorates with time, which means the asset fails to deliver its intended outcomes due to wear & tear and fatigue. An asset performance curve shown in Fig. -1 represents the condition of the asset across its life. Once, the asset fails to deliver it becomes redundant and it is necessary to opt for replacement.

Neglected maintenance and lack of upkeep of asset pose risk to the asset itself as well as to the surrounding other assets including health & safety risk to personnel. Sometimes, it may result in catastrophic consequences impacting the entire community at large. Typical risks from physical asset failure can result in exposure to physical hazards such as noise, vibration, entrapments, chemical hazards such as exposure to gas leaks, asbestos etc or even biological hazards in some cases. Therefore, there is a need to manage the organisation’s assets to ensure health and safety risks are managed in an appropriate manner.

The objectives of asset integrity management are:

- Assets deliver the desired performance across its life cycle.
- Assets are safe – ensuring a safe and healthy workplace to our workforce and other stakeholders.
- Assets meet statutory and regulatory requirements and comply with relevant regulatory and industry standards.
- Assets are ensured to have increased life, as applicable.

The process broadly consists of carrying out risk-based inspection (RBI) of assets, identifying asset risks, prioritising the risks based on impact of failure and probability of failure, and then risk mitigation by carrying out necessary engineering and site execution. To identify asset risks, inspectors rely on visual
inspections, non-destructive tests (NDTs), Drone surveys and condition monitoring. For rotating equipment such as fans, pumps, etc. condition monitoring is effective indicator for its health.

3. PROCESS CONDITION MONITORING

To avoid unplanned downtime, plant operators rely on condition monitoring systems to monitor the health of any rotating equipment. Process Condition Monitoring (PCM) is a process of monitoring the condition of an equipment in order to identify a significant change which provides indication of faults that can occur in future. It is one of the major components of predictive maintenance. The major parameters of condition monitoring are temperature, vibration and noise.

Temperature monitoring is one of the important features for condition monitoring of a rotating equipment. If any rotating equipment continues to operate over a long period of time without proper maintenance, then it can be ware out and it’s usually the mechanical part of the electromechanical device that starts to fail. This causes the equipment to draw more current leading to overheating or even fire. Substantial changes in temperature also affects the lubrication systems. Temperature monitoring system is the ideal way to provide an early warning of the above situation. Vibration is mechanical movement of a machine / equipment. Undesirable vibration can be caused by imbalance in rotating parts. By measuring the vibration, an early warning of un-wanted fault conditions like damaged bearing, misalignment, out of balance, cavitation etc. can be found. The total sound power emission from a motor can be considered a combination of three (3) noise sources acting together. Magnetic noise occurs from the temporal and spatial variations of magnetic force distribution in the air gap inside the motor. When a cooling fan operates inside the motor, it creates most of the cooling noise. Rotational noise is generated when an unsmooth body (rotor) rotates in a cavity that has obstacles and discontinuities or when the shaft and the bearings interact.

Apart from above mentioned parameters, lube oil condition, process pressure & flow and ultrasound also the part of condition monitoring.

Any deviation to the set or recommended parameter shows that the rotating equipment is not healthy and require maintenance. The conventional process involves the data is recorded and stored at a local server. The server generates a report highlighting the concern areas related to the parameters being monitored viz

Fig.-2 : Vibration trends for a Steam Exhaust Fan & Motor

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vibration, temperature or noise. Plant maintenance is carried out when there is an appreciable deviation to the set or recommended parameters.

Fig. 3: Process Condition Monitoring System

While condition monitoring offers an opportunity to collect data and perform analysis to sustain machine reliability, it in its current form depends mostly on human intelligence and decision making despite presence of augmented machine intelligence in terms of PLC based decision tree. The next stage of IIoT based process condition monitoring cater to agility in course correction through global collection of process data across different users and provide for predictive data analysis.

4. IIoT BASED PROCESS CONDITION MONITORING

IIoT enabled condition management extends the conventional condition monitoring to condition analysis and condition response involving artificial intelligence (Fig. 4). In case of conventional standalone PCM, the condition monitoring involves collection of process parameter data and analysing it to identify reasons for deviation and deciding on a maintenance plan. The decision on risk mitigation depends on human ability derived based on own / organisation knowledge.

IIoT system comprises of devices (hardware & software), communications, cloud platform & applications. Main goal of device is to collect data. It collects real time data through sensors, actuators, & existing control systems (such as PCM controller PLC, DCS or SCADA). Though Gateway, these data have been communicated to cloud by different communication protocol (such as Wi-Fi, WAN, LAN, 4G, 5G, LoRA, etc). Cloud platform provides data storage, data management & data analytics options. Data can be accessed anytime from anywhere. Applications can be web based or app based as per user requirement.
IIoT based condition analysis is supported by global data available in a cloud storage based on inputs from original equipment manufacturers (OEMs), other manufacturing organisations using similar equipment. Past performance and failure analysis data from the global source thus help in better assessment and decision making.

Condition response uses distributed artificial intelligence that allows decision making at local levels. Real-time sensing can be shared between the system controller i.e say a PLC and the condition monitoring controller [6-8]. This provides a functional interface enabled by an IIoT platform for mutual benefit related to machine performance and reliability.

5. CONCLUSION

As the proverb goes “A stich in time saves nine”. Agility is the key on today’s highly competitive and fast changing world. Ensuring proper predictive maintenance on time will ensure failure reductions and thereby improve the total maintenance spend by reducing break down or reactive maintenance spend which tends to cost any organisation higher as compared to planned maintenance cost. It also reduces
Human error and equipment malfunctioning by using expert system tools which enhance the safety of the system.

To ensure highly agile response in plant condition maintenance, data quality, latency and accuracy are key. Sustained machine reliability depends on agile responses to operating conditions and exposures to all things that present risk and impair reliability. IIoT based condition monitoring is therefore being deployed progressively across the world in manufacturing industries.

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Abstract

Flood is a serious problem mainly in regions which are close to rivers. Researchers studied the occurrence of flood, its consequences, and various remedial measures for many years. They proposed several flood modelling approaches to control floods and find the safest route from the flooded area. This study presents IoT-based architecture for real-time flood propagation monitoring and evacuation routing in a GIS environment. In this architecture, the first phase involves the delineation of flood hazard zonation. The second phase consists of real-time flood propagation analysis, and monitoring. The last stage determines flood evacuation routing and finding the safest route.

1. Introduction

Flood refers to the surge of a massive amount of water onto the generally dry land [1]. The leading cause behind flood occurrence is climatic phenomena, mainly rainfall. Still, many other natural and anthropogenic reasons play a triggering role behind the event and acceleration of floods [2]. Among all kinds of natural hazards, riverine flood is one of the most prevalent, devastating, and frequent phenomena. Riverine flood is a natural phenomenon in humid tropical and subtropical climatic regions, mainly in the monsoonal areas [3]. Each year, the scale of loss of lives [4], economic failure, damage of valuable assets, and property due to flood are tremendous throughout the world [5]. Hence, monitoring floodwater propagation and investigating possible safest evacuation routing are essential aspects of flood hazard management. This study aims to put forward a three-tier architecture for flood hazard zonation, real-time flood propagation monitoring, and evacuation routing using IoT sensors, GIS, and Remote Sensing.

2. Related Work

Geographical Information System or ‘GIS is an integrated system of computer hardware, software, spatial and non-spatial data with a user interface that captures, stores, retrieves, updates, analyses, and displays geographically referenced information or geospatial data’ [6]. These advanced analytical characteristics of GIS made it possible with remote sensing to monitor and forecast floods with very high accuracy. Satellite images are being widely used for flood zonation analysis and spatio-temporal extension and propagation of flooded water [7], [8], [9]. Flood propagation analysis depending upon the level of depth of flooded water and evacuation routing from the flooded area to the safest place is very important for planning strategies during the flood. These strategies help mitigate the loss due to flood [5], [8].

3. Flood Hazard Zonation Analysis

Flood hazard zonation analysis is essential for assessing flood-affected areas and quantitative investigation of flood inundated regions. It is beneficial for flood risk assessment, preparedness, and mitigation purposes. GIS and remote sensing assist micro-scale flood hazard zonation analysis based on triggering factors of flood according to their scale of impact. Several flood modeling approaches have been proposed for monitoring floods and finding out the safest route from the flooded area. This paper considers a previous preliminary study [10] on flood hazard zonation analysis to understand the proposed architecture. Among North-Eastern states of India, Assam is one such region that is prone to flooding by the Brahmaputra River. Kaziranga national park is one of the most significant ecological hubs in Assam. Fig. 1 represents the location map of the Kaziranga national park. Each year, this UNESCO world heritage site experiences severe floods, due to which the significant number of lives of animals gets threatened. Hence, it is essential to map flood hazard zones of Kaziranga. In [10], the authors considered factors like elevation, slope, drainage density, and

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landuse/landcover according to their importance on flood occurrence. Then they overlaid all these factors using weighted overlay analysis in ArcGIS. Landuse/landcover maps were prepared based on satellite image Landsat 8 OLI for March and November 2017 for a comparative study of pre-monsoon and post-monsoon season. Finally, they prepared flood hazard zonation maps for the pre and post-monsoon season of 2017, as shown in Fig 2. to understand the scenario of inundated regions before and after the monsoon.

![Fig. 1: Location map of Kaziranga National Park, Assam.](image-url)
Fig. 2: Maps of flood controlling factors (a) Slope (b) Soil (c) Drainage density and Landuse/landcover of (d) March and (e) November; Flood Hazard Zonation maps of Kaziranga National Park for (f) pre-monsoon (March) and (g) post-monsoon (November) of 2017.

4. Three tier GIoT Architecture

This study proposes a three-tier bottom-up architecture, ‘GIoT,’ comprising the advanced applications of GIS and IoT sensors. This work intends to create an architecture for real-time flood propagation monitoring and evacuation routing with a generalized view of riverine flood occurrence in any region. Fig.3 represents the steps of real-time flood propagation monitoring and evacuation routing. Here, GIS will help prepare, analyze, and map the control factors and sub-factors of the flood, database creation of all the considered sub-factors, mapping flood inundated areas, real-time flood propagation monitoring, and finding out evacuation routes and
safest places during the flood. IoT sensors facilitate real-time collection of data and incorporate with GIS environment to develop a real-time monitoring system of flood propagation. The detailed architecture is composed of three parts, illustrated in Fig. 4. The first part concentrates on flood hazard zonation mapping, the second part consists of flood propagation analysis and monitoring, and lastly, flood evacuation routing.

![Fig. 3: Steps of real time flood propagation monitoring and evacuation routing](image1)

![Fig. 4: Proposed three-tier bottom up GIoT architecture for real time flood propagation monitoring and evacuation routing.](image2)

### 4.1. Flood Hazard Zonation Mapping

Flood hazard zonation analysis is an essential part to understand flood propagation nature as described above in section no. 3. In this architecture, flood hazard zonation mapping comprises data collection of significant factors and sub-factors of flood from different primary and secondary sources and deployment of relevant IoT sensors; preparation of maps of the various factors in GIS and RS environment; and processing in GIS. The significant factors are soil, geology, hydrology, climate, topography, environment, and other factors (depends upon case study). Soil maps are prepared depending on different soil types and their characteristics. Geological information will help to design a lithology map of the flooded region. The sub-factors considered under hydrological factors are Drainage Density, Stream Power Index (SPI), Stream Transport Index (STI), Distance to stream, and depth of water level. IoT sensor helps to provide real-time depth of water level. GIS facilitates the mapping of hydrological sub-factors as drainage density map, SPI map, STI map, stream buffer map, and a map showing the depth of the water level. This framework will use climatic data, mainly real-time rainfall data using IoT sensors. These data will help to prepare a real-time rainfall distribution map.

Topographical factor includes elevation (DEM), slope, aspect, plan curvature, convergence index, slope distance gradient, Topographic Positioning Index (TPi), Topographic Wetness Index (TWI), Stream Power Index (SPI), and flow accumulation. Environmental factors include landuse/landcover (LU/LC) and vegetation cover. Satellite image helps to identify the distribution pattern of landuse/landcover over the study region. Normalized Difference Vegetation Index (NDVI) map will help to represent the growth and distribution of vegetation within the area of interest. This part consists of spatio-temporal change detection, and comparative study of landuse/landcover and NDVI to understand the effect of successive floods on LU/LC and vegetation growth within the flooded region with the help of temporal satellite data.

During analysis, relevant factors like a road map for urban, rural, and forest areas; building map for settlement areas; and animal corridor map for forest areas must be included. Road network map, Normalised Difference Building Index (NDBI), and Animal Corridor map will be prepared in GIS depending upon the

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research requirement. Analytical Hierarchical Process (AHP) will be considered for overlay analysis of these sub-factors as AHP provides better accuracy in overlay processing than conventional overlay process. Finally, the flood hazard zonation map will be prepared from the overlay analysis.

4.2. Flood Propagation Analysis and Monitoring

The flood propagation analysis and monitoring consist of four parts. Flood discharge analysis followed by water surface river profile analysis will help understand the study area’s discharge level and river profile characteristics. 2D hydraulic model analysis using HEC-RAS will be beneficial for understanding the hydrodynamic characteristics of the flow of flooded water. Based on these analyses and real-time data collected through IoT sensors, spatio-temporal real-time mapping of flood inundation profiles will be assessed. Lastly, real-time flood propagation will be analysed and monitored using real-time flood inundation profiles and maps of flood hazard zonation.

4.3. Flood Evacuation Routing

Flood evacuation routing is essential for flood management and planning purposes. In this part, topographic flood index analysis is a crucial step where the characteristics of flood propagation are analyzed with the effect of elevation and slope factors. Analysis of flood hazard zonation, flood propagation, and topographic flood index helps to determine flood evacuation routing and safest shelter mapping. Different other factors (depending upon case study area) are significant in analysing flood evacuation routing and safest place identification. As per the requirement of the study area, the analysis will include:

- Road network map.
- Building map (Normalised Difference Building Index for settlement area).
- Animal corridor map (for the forest, national park, or wildlife sanctuary area).

Neighborhood analysis and shortest path analysis of these factors will be helpful to find the best route to evacuate from the flooded area and to identify safe shelters.

5. Conclusion

The proposed GIoT architecture allows real-time flood propagation monitoring, evacuation routing, and safest shelter mapping. This architecture will be helpful in the research field of flood management and mitigation planning purposes that will reduce the loss of life and property. The architecture is applicable in vast flood-prone settlement areas, agricultural land, forest & sanctuary. Real-time monitoring of flood propagation with IoT sensors will make it possible to provide data of increasing water levels at an advanced stage, which will be beneficial for planning purposes of re-sheltering of people and or animals from the risk areas of the flood. The architecture will assist in forecasting flood probability and preparing an alert system for flood disaster management, urban & agricultural planning purposes.

References


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Refining the Industry and Business with Artificial Intelligence and Internet of Things

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Abstract - In the advanced business and industry ventures, Artificial Intelligence (AI) and Internet of Things (IoT) are playing great role in better customer experience, proficient client service, high functional productivity and reduction of processing time. With the principal objective of increasing business standard and the exploration of better approaches for serving clients while keeping up with minimal expense various techniques of AI and IoT are being strategically developed. AI and IoT being two strong technology, are contributing largely in the growth of Industry and business standard. People, organizations, and government offices use these models to extract knowledge from hidden information. AI models for the intricacy and variety of information in the business field are currently being created. This article presents a systematic summary about the refinement in business and industry due to application of AI and IoT.

1. Introduction

Progresses in AI devices have made artificial intelligence more open for organizations, as per review respondents. They recorded information security, process mechanization and client care as top regions where their organizations were applying AI. Natural Language Processing (NLP) is at the front line of AI reception, the report found that maximum portion of businesses are utilizing applications with NLP and IoT. Business pioneers, IT administrators, chief counsels, examiners and AI specialists agree with the vast development and extension of IoT and AI in this endeavour. Artificial intelligence and IoT can fundamentally bring down costs, increase expertise and lift business efficiency.

2. Literature Review

The significant role of IoT and artificial intelligence system are in business, industrial development, social marketing, data analytics, finance, retail shops and predictive analysis. These technology help to solve business prediction, sales forecasting, applied analytics etc. Explicitly these techniques stress on the planning of AI based customer satisfaction policy, information securing for AI, and building the AI environment. Important challenges and issues which are selected for research in this literature review are as follows.

- Appreciating the influence of Artificial Aptitude in Industry Ecosystem [1]
- Man-made brainpower Driven Organisation [2]
- Co-ordination of AI With Space challenges with Computational Aptitude and Supported Design[3]
- From Business to Information Conservational Quantum-Fuzzy Cryptography , considering a Cellular Transformation of Bipolar Fuzzy Sets to Quantum Machinery [4]
- Protection and Artificial Aptitude[6]
- Human-Computer Interaction and Understandable Artificial Aptitude in medical field with AI and IoT[7]
- Cost-Sensitive Parallel Knowledge Framework for Insurance Aptitude Operation [8]
- Man-made brainpower Driven Customized Manufacturing Factory: Key Technologies, Applications, and Challenges [9]
- Saddling the Power of Smart and Connected Health to Tackle COVID-19: IoT, AI, Robotics, and Blockchain for a Better World [10]
AI and IoT have been used as a vital device to investigate the universe in space missions. In the period of advanced technology, numerous industry areas, including space investigation, have encountered a change in the manner in which business is led because of the far reaching utilization of AI advancements [3]. In past years, AI has turned into a key apparatus used to investigate the universe in space missions. In [3] a multi-objective ideal plan for payload orbital exchange including space movement is proposed dependent on a computational intelligence-helped plan system with the artificial wolf pack algorithm (AWPA). Enlightened by the social practices of a wolf pack and its multitude intelligence, the AWPA is used for streamlining issues in which a logsig work arbitrarily gets tasks for guardians and posterity. The proposed strategy successfully performs advancement undertakings dependent on record of developmental pathway patterns, has been characterized to show the enhancing system. The outcomes show that the proposed approach turns out speedily for the streamlining of space tie model and its application. Fig.1 demonstrates different headings under which the literature review has been taken place for the current research.

<table>
<thead>
<tr>
<th>Entity-driven business insight for more intelligent choices</th>
<th>Security of IoT and Artificial Intelligence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man-made brainpower Driven Customized Manufacturing Factory</td>
<td>Human-Computer Interaction</td>
</tr>
<tr>
<td>Demand Forecasting Model Using BI Empowered With Machine Learning</td>
<td>Crowdsourced Business Intelligence</td>
</tr>
<tr>
<td>Achieving business goals with Business-Related Data IoT</td>
<td>Conservalional Quantum-Fuzzy Cryptography</td>
</tr>
<tr>
<td>Knowledge Framework for Insurance Management</td>
<td>Cellular Transformation of Bipolar Fuzzy Sets to Quantum Machinery</td>
</tr>
<tr>
<td>AI-Based Smart System for the Enhancement of the Lifespan of business</td>
<td>AI and IoT in Fin-Tech</td>
</tr>
</tbody>
</table>

Fig.1 Application of Artificial Intelligence and Internet of Things with concerned themes in Business development
3. Application of Artificial Intelligence in Business Environment

<table>
<thead>
<tr>
<th>SAP Co-pilot</th>
<th>Machine-Learning Contract Reviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>A digital assistant by SAP designed to help businesses with tasks like purchasing contracts and collaborating with colleagues.</td>
<td>Business consultancy Deloitte formed a partnership with machine-learning developer Kira Systems to create models that intend to quickly read thousands of complex documents, extracting and structuring textual information for better analysis.</td>
</tr>
</tbody>
</table>

Fig 2. AI in HR : SAP Co-pilot and ML Contract Review

Fig 2. Illustrates AI in HR : SAP Co-pilot and ML Contract Review and Fig 3. Shows AI in HR : AI-Sense and Walk-Me. Walk-Me is an useful AI-based human resource platform that supports chatbots and helps in customer service [27]. It is integrated with sales section to offer customized support and learning about proper operational activities in a business system. AI-Sense is an efficient application for human resource activities. Analysing the recorded calls, it uses artificial intelligence techniques to translate them to meaningful insights based on keywords that further applied analytics for better sales.

<table>
<thead>
<tr>
<th>AI-Sense: Call and Meeting Transcriptions</th>
<th>Walk-Me: AI for Software Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI-Sense, a Silicon Valley start-up founded last year, has released technology that is designed to make voice conversations accessible and searchable through its Ambient Voice Intelligence.</td>
<td>Walk-Me, a digital adoption platform, offers an artificial intelligence engine that enables business software to learn about user’s individual roles, habits and actions.</td>
</tr>
</tbody>
</table>

Fig 3. AI in HR : AI-Sense and Walk-Me

In Sales and marketing IoT and Artificial Intelligence play a great role to increase revenue. Many automated software have been developed which operate on machine learning theory. These systems have great contribution to accelerate activities in Sales and Marketing both.

Fig 4 depicts the application of Artificial Intelligence in Sales. These systems are used to analyze sales data. The companies are using AI to analyze millions and millions of sales conversations, then running it through AI algorithms and basically drawing specific conclusions. Artificial intelligence (AI) is helping companies to enhance overall sales performance. That's because this technology can automate and augment much of the sales process[30].

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MARKETMUSE | Marketing software analyzes thousands of topics on a given product/service and presents a blueprint of exactly how to write on a topic comprehensively to have an impact.

IMPORT-IO | “Import.io” extracts data for specific company and transfers it into desirable formats such as spreadsheets, reports, graphs and even APIs for internal applications. Whether you need marketing data across different websites or you need data related to equity & research or you need millions of data and images for machine learning and AI, import.io is your solution.

ACROLINX | Align your content to your strategy with the #1 enterprise content governance solution called “Acrolinx”. Acrolinx is the only platform that supports strategy aligned goals, you need to achieve.

GRAMMARLY | Grammarly.com is another AI-powered intelligent writing assistant to make people correct in business writing.

NETBASE | Net Base uses Social Media Analytics. It will show you details about everything that is happening with your brand instantly, all around the world. It alerts you when anything unusual happens to your brand/company.

Fig.5 depicts AI-powered software for Marketing. MARKETMUSE is a marketing software that analyzes thousands of topics on a given product/service and presents a blueprint of exactly how to write on a topic comprehensively to have an impact. “Import.io” extracts data for specific company and transfers it into desirable formats such as spreadsheets, reports, graphs and even APIs for internal applications. Whether you need marketing data across different websites or need data related to equity & research or need millions of data and images for machine learning and AI, import.io is your solution. Acrolinx is the only platform that supports strategy aligned goals you need to achieve. Grammarly.com is another AI-powered intelligent writing assistant to make people correct in business writing. NetBase uses Social Media Analytics. It will show you details about everything that is happening with your brand instantly, all around the world. It alerts you when anything unusual happens to your brand/company.

4. Application of IoT (Internet of Things) in Industry
An upgraded get to reservation convention with a halfway introduction transmission component for the limited band Internet of Things (NB-IoT) frameworks [26]. In this research, the proposed ARP can improve the ARP execution by moderating the event of prelude crashes, while being perfect with the regular NB-IoT ARP. It presents a diagnostic model that catches the execution of the proposed ARP as far as false alert, misdetection, and impact probabilities. In addition, we explore a tradeoff between the misdetection and the impact probabilities, and upgrade the proposed ARP as indicated by the framework loads. The outcomes demonstrate that the proposed ARP beats the regular NB-IoT ARP, specifically, at heavier framework loads. The fundamental thought of the proposed versatile strategy better communication with great performance improvement.
Fig. 6 describes application of Internet of Things in connected vehicles, traffic management and smart grids. These configurations include digital devices and IoT processors to manage activities. In traffic management, IoT has a lot of application in congestion control, car parking, accident management, smooth travel etc [29]. Many applications are also using IOT for efficient functioning and to enhance performance of energy-grids.

| **Connected Vehicles** | Autonomous vehicles are one of the most notable examples of IOT in action. Self-driving cars and trucks use a slew of connected devices to safely navigate roadways in all sorts of traffic and weather conditions. The technologies in use include AI-enabled cameras, motion sensors and on-board computers. |
| **Traffic Management** | Roadway infrastructure has become more connected in the past decade as well, with cameras, sensors, traffic light controls, parking meters and even smartphone traffic apps transmitting data that’s then used to help avert traffic jams, prevent accidents and ensure smooth travels. |
| **Smart-grids** | Connected devices now enable two-way communication along the entire energy supply chain: from generation through distribution to use, thereby, improving the utilities’ ability to move and manage it. Meanwhile, smart meters installed at individual homes and businesses provide information about both real-time use and historical usage patterns that customers and the utilities can analyse to identify ways to improve efficiency. |

Fig. 7 illustrates application of Internet of Things in Environment Monitoring and Supply chain management.

| **Environmental Monitoring** | Connected devices can collect data that indicates the health and quality of air, water and soil, as well as fisheries, forests and other natural habitats. They can also collect weather and other environmental data. As such, IOT delivers the ability to access significantly more real-time data about the environment. |
| **Smart buildings** | Property owners are using the power of IOT to make all sorts of buildings smarter, meaning they’re more energy efficient, comfortable and convenient, as well as healthier and possibly safer, too. |
| **Supply Chain Management** | Asset management and product tracking in supply chain involves IOT that helps the managers to plan confidently and locating the shipped items. Supply chain management has been undergoing a modernization, thanks to low-power sensors, GPS and other tracking technologies that pinpoint assets as they move along a supply chain. Such information lets managers both more effectively plan and more confidently reassure stakeholders about the location of items shipped or received. |

5. Conclusion
The prosecution of ultramodern technologies similar as Artificial Intelligence and IoT has been changing the entire business world. A recent check stated that nearly 500 IT professionals claiming Artificial Intelligence and Internet of Things (IoT) as utmost arising technologies do revamp business operations and compelling companies to invest further to gain a competitive advantage. And the reasons are simple. The combination of Internet of Things and Artificial Intelligence can produce smart strategies that can read mortal preferences and help operation make informed opinions with zero error. One of the world’s famed auto manufacturers, BMW, has started using AI and IoT in their manufacturing process. It uses cleaned robots in their demesne which help
workers while producing innovative buses. They're also using AI for driverless buses for the future. In fact, AI and IoT are affecting the entire transportation assiduity. Interactive charts and smart route optimization is making it easy for motorists to reach the destination beforehand. It saves energy cost and reduces trip time. This is why entrepreneurs embrace AI results in their hack application clone development because it plans routes grounded on peak hours and road construction.

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Smart Navigation Stick For Visually Impaired People Using IoT

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ABSTRACT

Blind people face many challenges day by day because they lack vision and usually, they should depend on other people. By considering this situation of blind people we have developed a system that helps a blind person to move from point A toward B without the need for other's help. In our system, we are implementing ultrasonic sensors that detect objects at a certain distance so that blind can get notified about the obstacles in front of him. Fire and water indicators have been carried out which helps the weakened if there is an abrupt burst of into flames or presence of Water before them. Assuming the visually impaired individual tumble down his stick is mounted with an accelerometer that recognizes the speed increase and the regulator makes the move by messaging to the overseer alongside the live area. In the event that the visually impaired appearances a crisis, we have given an emergency signal so the visually impaired individual can find support from the encompassing and furthermore from the guardian who gets an instant message alongside living area from the system. In expansion to these parts, we have executed optical person acknowledgment (OCR) utilizing tessaract OCR for character acknowledgment and Google message to discourse converter so the visually impaired can hear the characters that he expects to peruse. We have additionally executed picture order utilizing profound learning procedures so the visually impaired individual can know the article that is set before him.

1. INTRODUCTION

According to the WHO (World Health Organization)'s report in the year 2019, globally, out of the total world’s population, at least 2.2 billion people have blindness and visual Impairment problem, India projects a higher number of blind people at international forums. India currently has around 12 million blind people against 39 million globally -- which makes India home to one-third of the world’s blind population. Blind people generally have the difficulty in interacting with their environment, as it can be difficult to perceive where someone is, who he is and to get from one place to another place. There could be a lot of restriction in movement and mostly it is guided by people around, leading to have very little contact with the surrounding world. These people need some help to make their life easier and better. Hence the goal of this project to help blind people in recognizing the people and object with advanced deep learning techniques.

Electronic Travel Aids are gadgets that are utilized for portability. The capacity of ETA is to give data to the visually impaired individuals about street and obstructions. Our savvy walk stick is likewise an ETA that assists blind with people to be aware of the items inverse to them, the shade of the articles, and text perusing. In this shrewd strolling stick, we use Raspberry pi to control the sensors and camera. The element of article distinguishing proof assists blind with people to perceive what sort of item is before them and assists them with moving around securely. Text perusing helps them by perusing out the texts before them lastly, shading ID assists them with distinguishing the shading before them. These are completely done utilizing the strategy of advanced picture handling by utilizing process vision2. This shrewd walk stick is lightweight to haul around, and this assists the visually impaired individuals with moving around like typical individuals.

Vision assumes a significant part in gathering the vast majority of the data from this present reality and that data will be handled by the mind, outwardly disabled individuals endure bothers in their day by day and public activity. Visual impairment or visual hindrance is a condition that influences many individuals all over the planet. This condition prompts the departure of a significant feeling of vision. Overall there are a huge number
of outwardly disabled individuals, where a considerable lot of them are visually impaired. The requirement for assistive gadgets was and will be nonstop. There is a wide scope of route frameworks and instruments existing for outwardly hindered people. The visually impaired individual really requires a distinguishing object.

2. Related Work

A shrewd stick for the visually impaired and outwardly debilitated individuals where there are many issues over which people have no control visual deficiency is one of such issues. It grabs the striking visual magnificence of the world from a singular’s life. Yet, missing the magnificence of nature becomes one of the last concerns of such individuals as they need to confront various challenges to perform even the most nuts and bolts of undertakings in their everyday life[1]. One of their most prevailing issues is transport, like going across streets, going in trains, or other public spots. They generally need human help to do as such. In any case, once in a while they are delivered defenseless when no such help is advertised. Their conditions crumble their certainty. Customarily they have been utilizing the ordinary stick to direct themselves by contacting/jabbing snags in their direction. This causes a ton of mishaps and thus is risky for themselves as well as other people. As this is a mechanically determined period we chose to help these in an unexpected way abled individuals by concocting an innovation using arrangement. We consider it the "Brilliant Stick". It is a gadget which directs the client by detecting obstructions in the scope of stick. It will recognize all impediments in the way with the assistance of different sensors introduced in it. The microcontroller will recover information and pass it on as vibrations which will advise the client about obstacles coming. It is a productive gadget and will end up being a major help for blind individuals.

Proposed an independent strolling stick for the visually impaired utilizing echolocation and picture handling the brilliant strolling stick, the Assistor, assists outwardly tested individuals with distinguishing impediments and help arrive at their objective. The Assistor works dependent on the innovation of echolocation, picture handling, and a route framework. The Assistor might fill in as an expected guide for individuals with visual incapacities and henceforth works on their personal satisfaction. A ton of work and examination is being done to track down ways of further developing life for outwardly tested individuals. There are various strolling sticks and frameworks which assist the client with moving around, indoor and open air areas yet not a single one of them furnish runtime independent route alongside object recognition and ID cautions. The Assistor utilizes ultrasonic sensors to repeat sound waves and identify objects [2]. A picture sensor is utilized to distinguish the articles before the client and for route by catching runtime pictures and a Smartphone application is utilized to explore the client to the objective utilizing GPS (Global Positioning System) and guides.

Proposed an independent strolling stick for the visually impaired utilizing echolocation and picture handling the shrewd strolling stick, the Assistor, helps outwardly provoked individuals and designed[3]. The brilliant stick comes to work on the versatility of both visually impaired and outwardly weakened individuals. Stick arrangements utilize various advancements like ultrasonic, infrared, and laser however they actually have disadvantages. In this paper we propose, lightweight, modest, easy to use, quick reaction and low power utilization, brilliant stick dependent on infrared innovation. A couple of infrared sensors can recognize flights of stairs and different hindrances present in the client way, inside a scope of two meters.

An installed assistive stick for outwardly weakened people with a shrewd stick is expected and executed to help blind people so they can walk autonomously without much difficulty [4]. Fostered a high level gadgets based brilliant portability help for the outwardly weakened society. The domain of gadgets has been filling quickly in the beyond few decades [5]. Major works have been getting looked at for fostering a savvy stay with different sensors joined to it to be utilized as a portability help by the visually impaired as a piece of a continuous review. For looking for a smoother routine live and government assistance towards the visually impaired society, this paper proposed and investigated a novel idea for the visually impaired individual body itself [8]. The instrument of this framework, the electronic progression of the recognition sign, and criticism are represented.

BlinDar that is an undetectable eye for blind individuals making life simple for the visually impaired with the Internet of Things so the visual deficiency is a condition where an individual loses the visual insight. Portability and self-unwavering quality for the outwardly hindered and blind individuals have consistently been an issued [9]. In this paper, a shrewd Electronic Traveling Aid (ETA) called BlinDar has been proposed [6]. This savvy directing ETA enhances the existence of visually impaired as it is exceptional with the Internet of Things (IoT) and is intended to help the outwardly disabled and incognizant in regards to stroll without requirement in close

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just as open conditions. BlinDar is an exceptionally proficient, solid, quick reacting, lightweight, low power utilization, and savvy gadget for the blind [7]. MQ2 gas sensor is utilized for distinguishing fire in the way and a RF TX/Rx module for finding the stick when it is lost[10].

3. IMPLEMENTATION

Execution is the significant stage where the advancement of the proposed framework depends on the choices made already in the plan and framework necessity stage. Normally, the execution comprises of the accompanying steps:
• Planning
• Investigating the current framework and the prerequisites on implementations
• Providing preparing for the clients about the recently evolved framework.

3.1 SELECTING PLATFORM

The platform is the one on which a program runs. Most platforms are a combination of the OS and the hardware.

Raspbian OS

Albeit the Raspberry Pi's working framework is nearer to the Mac than Windows, it's the last option that the work area most intently takes after It may appear to be somewhat outsider from the get go, yet utilizing Raspbian is not really any unique to utilizing Windows (notwithstanding Windows 8 obviously). There's a menu bar, an internet browser, a record administrator, and no lack of work area alternate ways of pre-introduced applications. Raspbian is an informal port of Debian Wheezy arm with arrangement settings acclimated to create an upgraded "hard float" code that will run on the Raspberry Pi. This gives essentially quicker execution to applications that utilize drifting point math tasks. The design of Raspberry Pi portrayed in fig. 1.

Fig. 1. Raspberry Pi

Tesseract OCR

Python Tesseract is an Optical Character Recognition (OCR) motor for different OS. Tesseract OCR is the course of electronically extracting text from pictures and reusing it in an assortment of ways such as archive altering, free-text look. OCR is an innovation that is fit for changing over reports like filtered papers, PDF documents, and caught pictures into editable information. Tesseract can be utilized for Linux, Windows, and Mac OS. It very well may be utilized by software engineers to remove composed, printed text from pictures utilizing an API. Tesseract can utilize GUI from the accessible outsider page. The establishment cycle of tesseract OCR is a mix of two sections The motor and preparing information for a language Tesseract up to and including adaptation 2 could just acknowledge TIFF pictures of straightforward one-segment text as data sources. These early forms did exclude design investigation, thus contributing multi-segmented text, pictures, or conditions delivered jumbled result. Since variant 3.00 Tesseract has upheld yield text organizing, OCR positional data, and page-format examination. Support for some, new picture designs was added utilizing the Leptonica library. Tesseract can distinguish whether the text is monospaced or relatively separated. In our project Tesseract is used to convert the captured image text into text format.
Fig. 2. Architecture of proposed system

MODULE DESCRIPTION

The project consists of four different modules: Obstacle Detection, Emergency Feature, Image Processing, and Fire Detection.

Obstacle Detection

This module focuses on issues identified with hindrances in transit of a visually impaired individual. The hindrance discovery happens utilizing the UV sensor. The primary justification for utilizing the UV sensor is that it requires a bigger distance than some other sensor. It offers phenomenal reach precision and stable readings in a simple to-utilize bundle. UV Sensor is utilized for identifying the power of episode bright (UV) radiation. In the snag recognition module, repetitive ultrasonic sensors are utilized to expand location goal and sensor information unwavering quality. Since ultrasonic sensors have a width dihedral location point, the goal of distinguished obstructions is exceptionally low. The carried out approach utilizes consistently three ultrasonic sensors for one portion of a similar point. Henceforth, however the triple measure of sensors is required, the repetition and goal are likewise significantly increased. This type of electromagnetic radiation has more limited frequencies than apparent radiation. It can distinguish protests up to 176cms. The working of the feature in the form of Algorithm is as follows:

Step 1: Import the RPi GPIO pins.
Step 2: Set the GPIO pins mode as BCM mode.
Step 3: Set the GPIO_TRIGGER Pin=18 and GPIO_ECHO = 24 for one sensor. TRIGGER = Output and ECHO = Input
Step 4: Start transmitting signals after the RPI OS boots up.
Step 5: Give an interval in between for 0.01ms.
Step 6: Call the time function and define Start Time and Stop Time.
Step 7: Calculate the Time Elapsed by taking the difference between Start Time and Stop Time.
Step 8: Multiply with the sonic speed (34300cm/s) and divide by 2 for transmitting and receiving.
Step 9: Returns the distance and then the direction is heard as voice output.

Disaster Feature

This module focuses on a crisis switch utilizing which a visually impaired individual's crisis can be identified. An accelerometer is utilized to make this component work. The ADXL335 is a little, unstable, low power, complete 3-turn accelerometer with signal shaped voltage yields. The thing gauges speed increment with a base full-scale extent of ±3 g. It can measure the static speed increment of gravity in incline identifying applications, similarly as novel speed increment coming about due to development, shock, or vibration.
Image Processing

Image handling is any type of processing for which the information is a picture or a progression of pictures or recordings, like photos or edges of video. The result of picture handling can be either a picture or a bunch of qualities or boundaries identified with the picture. It likewise signifies "Dissecting and controlling pictures with a PC". Picture handling is acted in the accompanying three steps:

First, import pictures with optical gadgets like a scanner or a camera or straightforwardly through computerized handling. Second, control or investigate the pictures here and there. This progression can incorporate picture improvement and information rundown, or the pictures are dissected to find decides that aren't seen by the natural eyes. For instance, meteorologists utilize this handling to investigate satellite photos. Last, yield the consequence of picture handling. The outcome may be the picture changed somehow or another or it very well may be a report dependent on investigation or consequence of the pictures. RGB image to gray scale image conversion:

Red tone has more frequency of the multitude of three tones, and green is the shading that has less frequency than red tone as well as green is the shading that gives a more alleviating impact to the eyes. So the new condition that structure is:

\[ \text{New dark scale picture} = ((0.3 \times R) + (0.59 \times G) + (0.11 \times B)) \]

According to this situation, Red has contributed 30%, Green has contributed 59% which is more prominent in each of the three tones and Blue has contributed 11%.

The working is displayed in the accompanying steps:

- A RGB picture can be three pictures stacked on top of each other.
- Each shading pixel is a trio that compares to the red, blue, and green shading parts of RGB picture at a predetermined spatial location.
- Similarly, A dark scale picture can be seen as a solitary layered image.
- Here, we utilize the Harcascade calculation which deals with Python.

Fire Exposure

A sensor that is for the most part sensitive to an average light is known as a fire sensor. That is the explanation this sensor module is used in alerts. This sensor perceives fire regardless recurrence inside the extent of 760 nm – 1100 nm from the light source. This sensor can be helpfully hurt to high temperatures. So this sensor can be set at a particular partition from the fire. The fire acknowledgment ought to be conceivable from a 100cm distance and the area point will be 600. The aftereffect of this sensor is a basic sign or progressed sign. These sensors are used in firefighting robots like an alarm.

When the distance between the lighter and fire sensor is 80cm, the fire can be recognized by the sensor. The bigger the fire is, the farther the distinguished distance can be. The fire sensor is delicate to the fire radiation range in case the identified point is 60 degrees.

4. Conclusion

The proposed project is very useful for visually impaired people. Using this device easy voice response can be given to blind people. Implementation of the project is based on Image processing techniques with novel deep learning algorithm and ultrasonic sensors which gives the accurate information about obstacle, fire detection and voice recognition to the Blind people. However, there are significant works done to make this device to become a true product for visually impaired people and the hardware size, cost of the device is limited. The proposed device has the potential to aid blind people in interacting with their environment with easy behavior.

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